



FCC PART 15.225
MEASUREMENT AND TEST REPORT

For

Escort Memory Systems

170 Technology Circle
Scotts Valley, California 95066

Model: C0405
FCC ID: E36-C0405

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1 GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

The *Escort Memory Systems*' product model: C0405 is a RFID Reader/Writer. It is capable of sending and receiving data to a RFID transponder via the backscatter principle. The reader can interface with a host computer for the purpose of control and data transfer. Internal to each C0405 reader are four PCBs. These boards consist of a connector, main, LED and antenna sub-assemblies. Internal circuit variations are primarily related to the host data interface type. Currently there are three models. These are a RS232, RS485 and USB serial data types. The USB model does not have an internal 5 VDC switching regulator and is powered from the host USB port. There are three different connector boards, each of which has specific circuitry appropriate for the serial data type.

1.2 EUT Photo



C0405-232-01



C0405-USB-01



C0405-485-01

Please see additional photos in Exhibit C

1.3 Mechanical Description

The EUT measures approximately 56.2 mm (L) x 40 mm (W) x 24 mm (H).

** The test data gathered is from production samples, serial number: 01, provided by the manufacturer.*

1.4 Objective

This Type approval report is prepared on behalf of *Escort Memory Systems* in accordance with Part 2, Subpart J, and Part 15 Subpart C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules, Part 15, sec 15.35, sec 15.203, sec 15.205, sec 15.207, sec 15.209 and sec 15.225.

1.5 Related Submittal(s)/Grant(s)

No Related Submittals.

1.6 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All radiated and conducted emissions measurements were performed at Bay Area Compliance Laboratory, Corp.

1.7 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from ± 2.0 for Conducted Emissions tests and ± 4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

Detailed instrumentation measurement uncertainties can be found in BACL report QAP-018.

1.8 Test Facility

The test site used by BACL Corp. to collect measurement data is located at its facility in Sunnyvale, California, USA.

The test sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0).



The current scope of accreditations can be found at <http://ts.nist.gov/Standards/scopes/2001670.htm>

2 SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2003.

2.2 EUT Exercise Software

Run RFID simulation program provided by customer.

2.3 Special Accessories

N/A

2.4 Equipment Modifications

No modifications were made to the EUT

2.5 Remote Support Equipment

N/A

2.6 Internal Configuration

Manufacturer	Description	Part Number	Rev
Escort Memory	PCB Board	10-1393	-
Escort Memory	PCB Board	10-1368	-
Escort Memory	PCB Board	10-1365-232	-
Escort Memory	PCB Board	10-1366-485	-
Escort Memory	PCB Board	10-1365-USB	-

2.7 Local Support Equipment

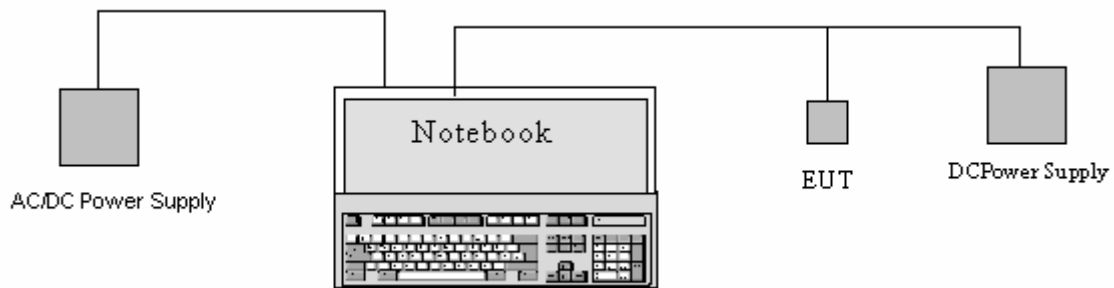
Manufacturer	Description	Model	Serial Number
Dell	Laptop Computer	N/A	N/A

2.8 Interface Ports and Cabling

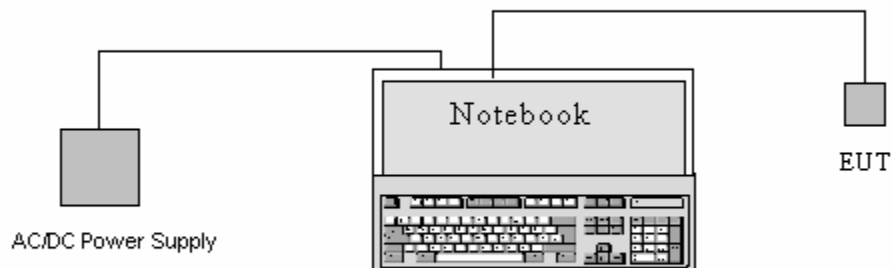
Cable Description	Length (m)	From	To
Serial Cable	<3m	EUT	Laptop
USB Cable	<3m	EUT	Laptop
485 Cable	<3m	EUT	Laptop

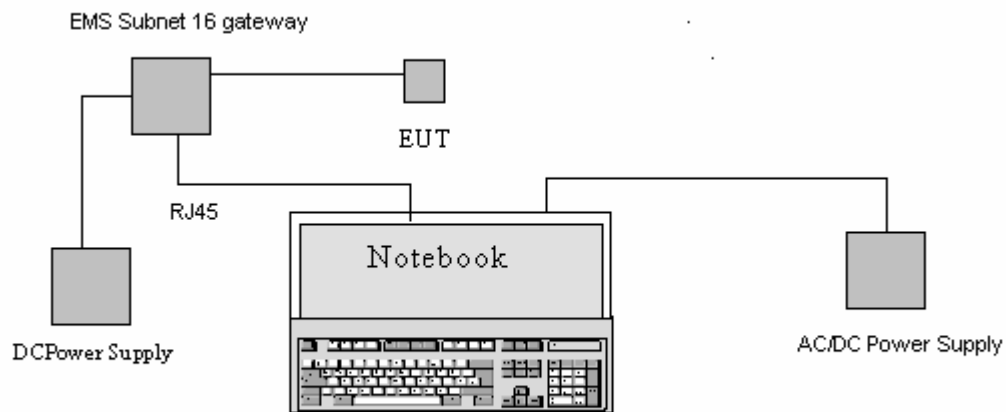
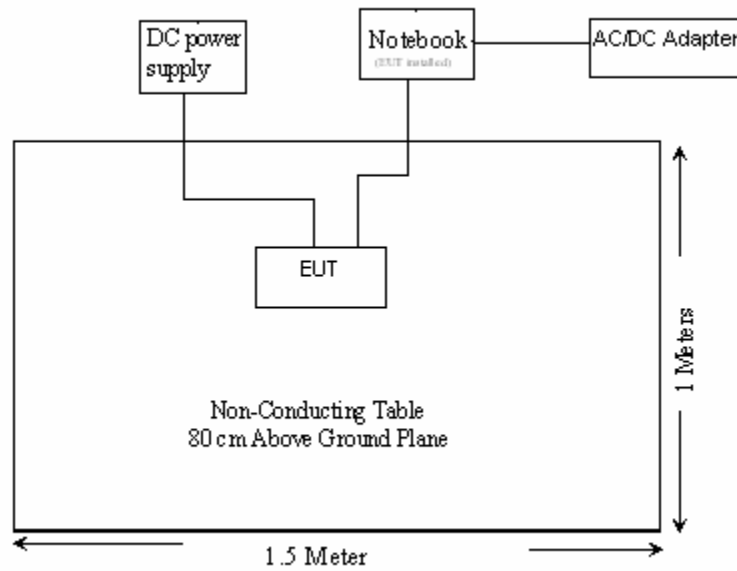
2.9 Test Setup Configuration

C0405-232-01



C0405-USB-01



C0405-485-01**2.10 Test Setup Block Diagram**

3 SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliant
§ 15.35 § 15.205 § 15.209 § 15.225	Radiated Emission	Compliant
§ 15.207	Conducted Emission	Compliant
§15.225(e)	Frequency Stability	Compliant

4 § 15.203 – ANTENNA REQUIREMENT

4.1 Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Refer to statement below for compliance.

“The antenna for this device is an integral antenna that the end user cannot access. Furthermore the device is for indoor/outdoor use as detailed in the Users Manual and Operational Description.

4.2 Result

Compliant.

5 § 15.35, § 15.205, § 15.209, § 15.225 - RADIATED EMISSION TEST

5.1 EUT Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup accordance with the ANSI C63.4-2003. The specification used was the FCC 15 Subpart C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of test table and bundle when necessary.

The EUT was placed on the center of the back edge on the test table.

5.2 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Sonoma Instrument	Pre- Amplifier	317	260407	2007-04-26
HP	Analyzer, Spectrum	8565EC	3946A00131	2007-01-24
Com-Power	Active Loop Antenna (10KHz-30MHz)	AL-130	17043	2006-03-06**
Sunol Sciences	30MHz~2GHz Antenna	JB1	A03105-3	2006-03-15**
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2007-03-13

* **Statement of Traceability:** BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

** 2 years calibration cycles

5.3 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT is compliant with all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings performed only when an emission was found to be marginal (within -4 dB of specification limitation), and are distinguished with a "QP" in the data table.

The EUT was operating at normal to represent worst case during final qualification test. Therefore, this configuration was used for final test data recorded in the following table of this report.

5.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

5.5 Environmental Conditions

Temperature:	18 °C
Relative Humidity:	58 %
ATM Pressure:	102.2 kPa

* Testing was performed by Choon Sian Ooi on 2007-07-06.

5.6 Summary of Test Results

According to the data in the following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.225/209. The EUT measured within the measurement uncertainty of ± 4.0 dB, and had the worst margin reading of:

-18.15 dB at 27.12 MHz for 9 kHz to 30 MHz.

-5.1 dB at 33.9562 MHz in the **Vertical** polarization for 30 to 1000 MHz

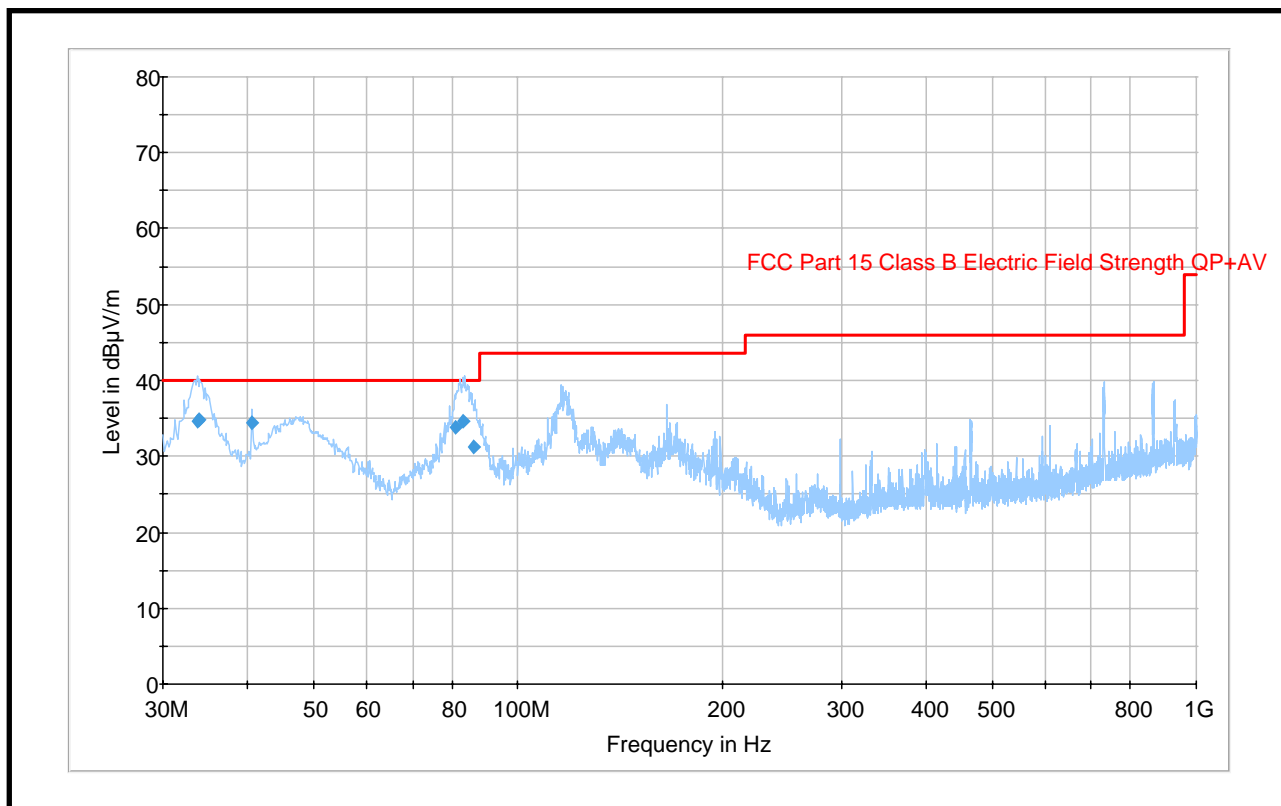
5.7 Radiated Emissions Test Result Data @ 3meter

9 kHz to 30MHz

Frequency (MHz)	Reading (dBuV)	Turntable Degrees	Ant Height (m)	Ant Factor (dB/m)	Cable Factor (dB)	Distance Factor (dB)	Correction Reading (dBuV/m)	FCC 15C	
								Limit (dBuV/m)	Margin (dB)
27.12	40.65	170	1.3	10.5	0.2	40	11.35	29.5	-18.15
13.567	49.5	170	1.2	11.2	0.1	40	20.8	50.5	-29.7
13.553	48.5	79	1.2	11.2	0.1	40	19.8	50.5	-30.7
13.710	31.9	79	1.1	11.2	0.1	40	3.2	40.51	-37.31
13.410	30.6	170	1.2	11.2	0.1	40	1.9	40.51	-38.61
13.56	55	79	1.2	11.2	0.1	40	26.4	84	-57.6

Radiated Emissions Test Result Data @ 3meter

30MHz to 1GHz



Quasi Peak Measurement

Frequency (MHz)	Quasi-Peak (dBμV/m)	Antenna Height (cm)	Polarity	Turntable Position (deg)	Corr. (dB)	Limit (dBμV/m)	Margin (dB)
33.956250	34.9	100.0	V	214.0	2.9	40.0	-5.1
83.231250	34.7	98.0	V	335.0	-6.3	40.0	-5.3
33.798750	34.6	98.0	V	330.0	3.0	40.0	-5.4
40.670000	34.5	99.0	V	115.0	-1.6	40.0	-5.5
81.083750	33.8	100.0	V	322.0	-6.4	40.0	-6.2
86.062500	31.2	100.0	V	329.0	-6.2	40.0	-8.8

6 §15.207 – CONDUCTED EMISSIONS

6.1 Applicable Standard

According to FCC §15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

**Decreases with the logarithm of the frequency*

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4 – 2003 measurement procedure. The specification used was FCC Class B limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT was connected with LISN-1.

6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Solar Electronics CO	Artificial-Mains Network	9252-50-R-24-N	0511213	2006-07-07
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2007-03-13

*** Statement of Traceability:** BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

6.4 Test Procedure

During the conducted emissions test, the power cord of the EUT was connected to the mains outlet of the LISN-1.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a “QP”. Average readings are distinguished with an “Ave”.

6.5 Environmental Conditions

Temperature:	24 ° C
Relative Humidity:	65 %
ATM Pressure:	102. 0 kPa

* Testing was performed by Choon Sian Ooi on 2007-07-06.

6.6 Summary of Test Results

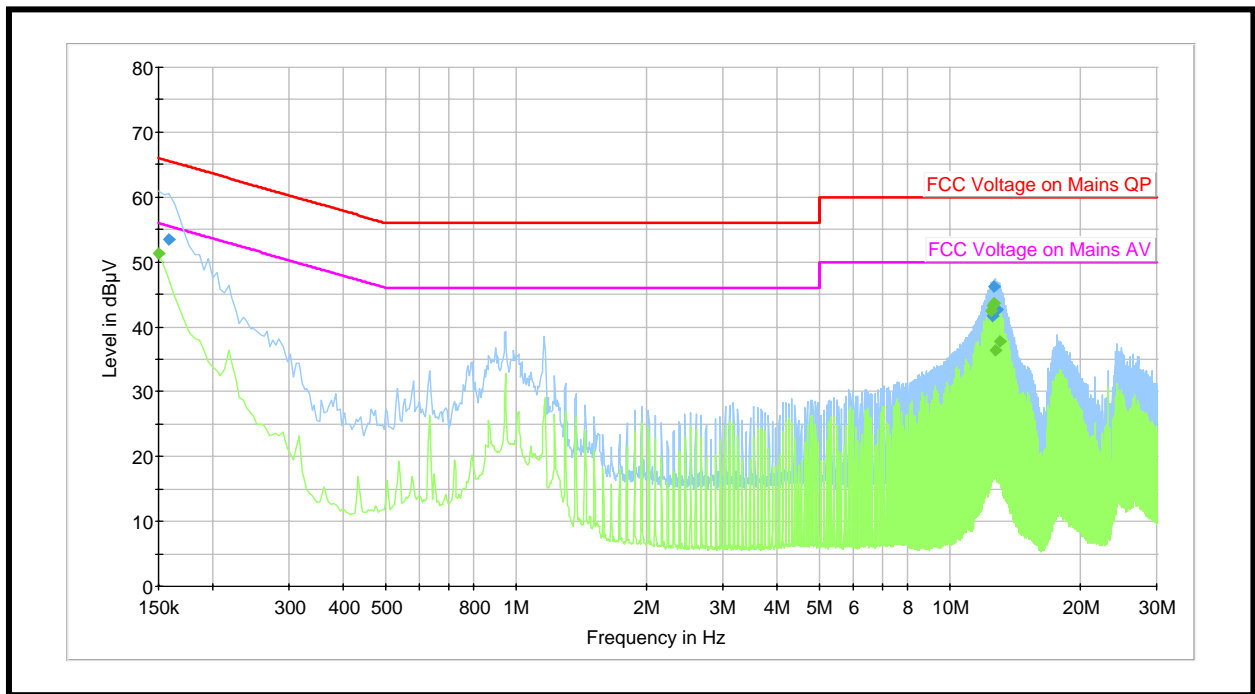
According to the recorded data in following table, the EUT complied with the FCC standard's conducted emissions limits for Class B devices, with the *worst* margin reading of:

-4.7 dB at 0.150000 MHz in the Hot Conductor

Please refer to the following plots and tables for complete test results

6.7 Conducted Emissions Test plot & data

120 V, 60 Hz – Hot

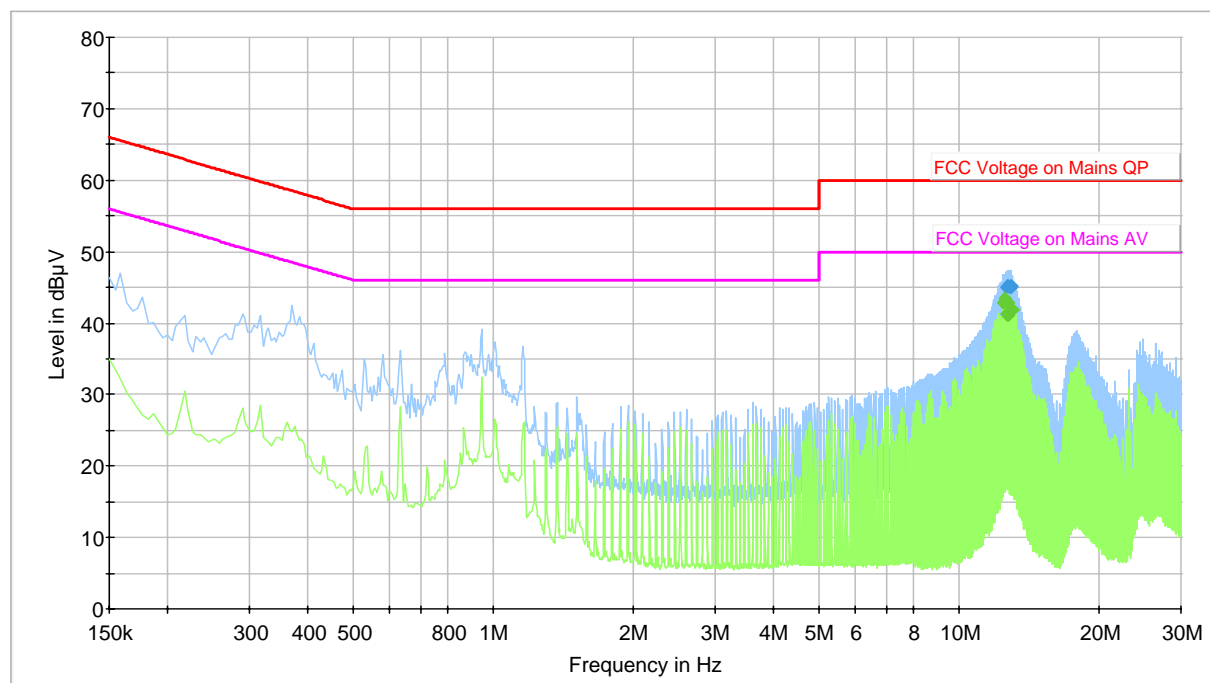


QP Measurements

Frequency (MHz)	Quasi-Peak (dBμV)	Conductor (H/N)	Limit (dBμV)	Margin (dB)
0.159000	53.5	H	65.5	-12.0
12.637500	46.2	H	60.0	-13.8
12.786000	42.7	H	60.0	-17.3
12.858000	42.6	H	60.0	-17.4
12.714000	42.5	H	60.0	-17.5
12.570000	41.7	H	60.0	-18.3

Average Measurements

Frequency (MHz)	Quasi-Peak (dBμV)	Conductor (H/N)	Limit (dBμV)	Margin (dB)
0.150000	51.3	H	56.0	-4.7
12.637500	43.6	H	50.0	-6.4
12.565500	43.3	H	50.0	-6.7
12.493500	42.5	H	50.0	-7.5
13.002000	37.7	H	50.0	-12.3
12.714000	36.3	H	50.0	-13.7

120 V, 60 Hz – Neutral**QP Measurements**

Frequency (MHz)	Quasi-Peak (dBμV)	Conductor (H/N)	Limit (dBμV)	Margin (dB)
12.637500	44.9	N	60.0	-15.1
12.709500	45.2	N	60.0	-14.8
12.781500	45.2	N	60.0	-14.8
12.853500	45.0	N	60.0	-15.0
12.925500	45.1	N	60.0	-14.9
12.997500	45.2	N	60.0	-14.8

Average Measurements

Frequency (MHz)	Quasi-Peak (dBμV)	Conductor (H/N)	Limit (dBμV)	Margin (dB)
12.489000	42.9	N	50.0	-7.1
12.561000	43.5	N	50.0	-6.5
12.637500	41.3	N	50.0	-8.7
12.705000	42.8	N	50.0	-7.2
12.781500	41.0	N	50.0	-9.0
13.069500	41.8	N	50.0	-8.2

7 § 15.225(e) - FREQUENCY STABILITY MEASUREMENT

7.1 Standard Applicable

According to FCC §15.225(e), the frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+ 50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

7.2 Test Procedure

7.2.1 Frequency stability versus environmental temperature

The equipment under test was connected to an external AC power supply and the RF output was connected to a frequency counter via feed through attenuators. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

7.2.2 Frequency Stability versus Input Voltage

At room temperature ($25\pm 5^{\circ}\text{C}$), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial No.	Calibration Date
HP	Analyzer, Spectrum	8565EC	3946A00131	2007-01-24
Tenney	Oven, Temperature	VersaTenn	12.222-193	2006-06-21**
Hp	Counter, Microwave Frequency	5342A	2232A06380	2007-01-26

* **Statement of Traceability:** BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

** 2 years calibration cycles

7.4 Environmental Conditions

Temperature:	18 °C
Relative Humidity:	58 %
ATM Pressure:	102.2 kPa

Testing was performed by Choon Sian Ooi on 2007-07-06.

7.5 Test Results

Model: **C0405-485-01**

Condition Voltage (DC)	Temperature (°C)	Ref. Freq. (Hz)	Measured Freq. (Hz)	Freq. Error (Hz)	Limit (Hz)
24.0	-20	13560000	13559210	-790	1356
24.0	-10	13560000	13559520	-480	1356
24.0	0	13560000	13559720	-280	1356
24.0	20	13560000	13560800	800	1356
24.0	30	13560000	13560923	923	1356
24.0	50	13560000	13560989	989	1356
20.4	20	13560000	13560810	810	1356
27.6	20	13560000	13560810	810	1356